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November 12, 2007

VIA ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: SHURE INCORPORATED PROPOSED LABORATORY AND FIELD TEST PLAN FOR INTERACTION OF WHITE SPACE DEVICE PROTOTYPES AND PART 74 WIRELESS MICROPHONES

ET Docket No. 04-186; Unlicensed Operation in the TV Broadcast Bands

Dear Ms. Dortch:

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. § 1.1206, Shure Incorporated ("Shure") supplements the record in the above-referenced proceeding with the attached proposed test plan regarding White Space Device ("WSD") and Part 74 wireless microphones. This plan is intended to assist the Commission in developing meaningful technical data as it considers the difficult interference issues raised by the proposals in this proceeding. The plan includes a series of essential laboratory and "real world" field tests for WSD prototypes to measure interference caused by WSDs and the ability of WSDs to protect Part 74 wireless microphones from interference. The plan outlines:

- Detailed laboratory testing, including an evaluation of a full suite of Dynamic Frequency Selection ("DFS") parameters, all of which Shure believes are critical to evaluating interference from WSD transmissions and the ability of WSD prototypes to protect Part 74 wireless microphones from interference;

- Detailed "real-world" field testing proposed to be conducted at specified upcoming live National Football League ("NFL") events. These tests measure across a range of conditions that Shure believes are critical to evaluating the ability of WSD prototypes to protect Part 74 wireless microphones from interference in "real world" circumstances.

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- Live NFL events were selected for initial field testing because they represent a variety of environments that are typical for wireless microphone uses. The proposed NFL event tests have been designed in close cooperation with the NFL and Society of Broadcast Engineers Game Day Frequency Coordinators to minimize the risk of interference to live broadcasts and event transmissions.

- "Real world" field tests of WSDs, such as the proposed live NFL events, are essential to assess the interaction of WSDs and Part 74 wireless microphones. Shure expects to propose additional test locations and environments that will be critical to assess WSD behavior in other typical wireless microphone use environments.

If you have any questions regarding this plan, please do not hesitate to contact the undersigned.

Very truly yours,

/s/

Catherine Wang

cc: Mark Brunner
Ahren Hartman
Edgar Reihl

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FCC Test Plan for White Space Device (WSD) Interaction with Wireless Microphones

November 12, 2007

1.0 Overview

This document describes a number of test cases designed to assist the FCC in evaluating White Space Device (WSD) prototypes that would operate in unassigned portions of the TV bands. Shure sets forth specific procedures, and the rationale for using such procedures, for both laboratory and real-world field-testing of WSDs and their interaction with Part 74 wireless microphones. Shure stands ready to assist the Commission, as appropriate, in the testing program. In particular, Shure offers assistance to the Commission in making necessary arrangements for the conduct of field-testing. In keeping with the Commission's stated intent to conduct open testing, Shure specifically seeks involvement in defining the test cases, and also monitoring and participating in the actual testing process, as appropriate.

The proposed test cases are geared towards issues directly related to the expected sharing of unassigned TV band channels by Part 74 devices and WSDs. The topic is of critical importance to Shure, as we have a vested interest in ensuring that the sharing is done in a way that least impacts wireless microphone users, which already operate in locally unused TV channels.

We recognize that this plan is subject to change as more information about White Space Devices becomes known, and as additional concerns about co-existence between them and wireless microphones become apparent. Included here are concerns related to WSDs in general, but also some specific issues related to Personal/Portable devices (which are just one set of expected TV band White Space Devices).

The proposed tests are primarily intended for evaluating Personal/Portable devices, but could also be applicable to Fixed/Access devices. Both device types are being considered for deployment in unassigned TV channels. The tests are broken down into two categories: laboratory tests, and "real world" field tests. In each case, the following must be evaluated:

1. Ability of the WSD to sense Part 74 device transmissions across a range of conditions and circumstances
2. Actions, or "behaviors" of the WSD in response to detection of Part 74 devices
3. Measurement of WSD transmission characteristics
4. Measurement of Part 74 signal degradation due to WSD transmission
5. Confirmation of the backup channel sensing procedure employed by the WSD

2.0 Laboratory Tests

For the laboratory tests, all tests must be done on a conducted basis; i.e., the devices and test equipment must be interconnected using coaxial cables to ensure that the primary path between a transmitter and a receiver will be via conduction rather than radiation.

Test conditions:

Wireless microphones that are being used as signal sources shall be adjusted to transmit on one of three frequencies within the test TV channel, as follows:

1. Low channel: carrier frequency set at +0.2 MHz from bottom edge of TV channel

2. Mid channel: carrier frequency set at +3.0 MHz from bottom edge of TV channel
3. High channel: carrier frequency set at +5.8 MHz from bottom edge of TV channel

Additional wireless microphones on other frequencies could be added at the discretion of OET.

2.1 Sensing of Part 74 Devices by White Space Devices.

Test objective: Confirm that the White Space Device includes techniques/algorithms that enable it to reliably detect the presence of Part 74 devices under a variety of conditions. The actual sensing technique may be based on any number of concepts. However, the mechanism must be able to detect signal levels as low as –116 dBm for Part 74 wireless microphones, as recommended in the FCC Further Notice of Proposed Rule Making, ET Docket No. 04-186, and with a high degree of reliability (e.g., 95%). In addition, it must be able to do this in the presence of strong DTV signals on adjacent channels (e.g., N+/– 1 and N+/–2).

Test procedure:

Measure the sensitivity of the mechanism the WSD employs for detecting wireless microphones to a defined level of accuracy (e.g., 95%). When wireless microphone signals are present at or above –116 dBm, the sensing logic in the WSD must correctly indicate that a wireless microphone is present.

- Sensitivity measurements should be carried out on at least two TV channels within the tuning range of the equipment under test.
- Within each TV channel, test using a single wireless microphone operating on the low channel, mid channel, and high channel frequencies
- Within each TV channel, test using two wireless microphones operating on the low and mid channel frequencies, mid and high channel frequencies, and low and high channel frequencies
- Within each TV channel, test using three wireless microphones operating on the low, mid, and high channel frequencies

Sensitivity tests should be performed in each of the following configurations:

1. Only wireless microphone signals present
2. Wireless microphones, plus one DTV signal at N+1
3. Wireless microphones, plus one DTV signal at N–1
4. Wireless microphones, plus two DTV signals at N+1 and N–1
5. Wireless microphones, plus two DTV signals at N+1 and N+2
6. Wireless microphones, plus two DTV signals at N–1 and N–2

For each of the configurations involving DTV signals in combination with wireless microphones, the level of the DTV signals should be varied from –75 dBm (simulating a weak but usable DTV signal) up to –20 dBm (simulating a very strong DTV signal, such as would be present at an outdoor venue near a TV transmitter). The behavior of the WSD should be explored as the DTV signal level is varied within this range, and an appropriate number of levels should be used to demonstrate its performance.

2.2 Dynamic Frequency Selection (DFS) Behavior of White Space Devices When Part 74 Devices Are Detected

Test Objective: Confirm that the WSD takes corrective action within an appropriate time limit when incumbent Part 74 users operating in the same TV channel are detected, in order to ensure that it does not interfere with them. The time taken by a White Space Device to cease all transmissions on the current TV channel upon detection of an incumbent device is referred to as

the “Channel Move Time.” In previously filed comments [1], Shure has recommended a time of 2 seconds. Hence, a critical element to the testing will be verification of the WSD’s ability to regularly monitor for the presence of Part 74 devices in such a way that it can quickly vacate the channel to avoid interfering. Note that previous tests of WSDs have focused solely on detection, without assessment of required DFS behaviors. However, WSDs should be tested for performance regarding all DFS parameters.

It is worth noting that this testing is critical to perform on WSDs aimed at the personal/portable space if sensing is the primary mechanism by which these devices determine the presence of Part 74 devices. Other techniques, such as those based on Geo-location, may not be feasible for portable and mobile devices.

Test Procedure:

1. Configure a pair of WSD transceivers to operate normally (e.g., exchanging data) in the desired test TV channel; e.g., channel N.
2. Turn on a Part 74 wireless microphone transmitter and receiver system in the same TV channel N.
3. Confirm that each WSD is able to sense the presence of the wireless microphone transmitter (i.e., the system employs network sensing)
4. Observe the WSD system behavior. Within the “Channel Move Time” (2 sec) after the Part 74 system is turned on, the White Space Devices should cease transmission completely.
5. Repeat the test with multiple wireless microphones
6. Repeat the test for each of the configurations described above with DTV signals present

DFS Parameter for Wireless Microphone Detection and Interference Avoidance	**Value**
Channel Availability Check Time	60 sec
Non-Occupancy Period	60 minutes
Channel Detection Time	500 msec
Channel Setup Time	2 sec
Channel Opening Transmission Time (Aggregate transmission time)	D/U dependent
Channel Move Time (In-service monitoring)	2 sec
Channel Closing Transmission Time (Aggregate transmission time)	D/U dependent
Interference Detection Threshold	-116 dBm*

*Interference detection threshold revised to conform to FCC recommendation.

2.3 Measurement of WSD Emissions in the Designated & Adjacent TV Channels

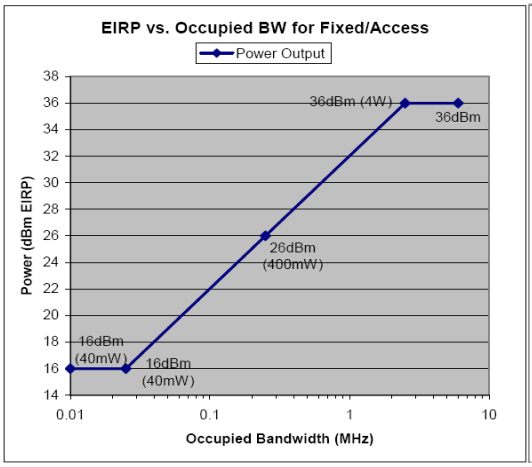
Test objective: Monitor and characterize the transmission power of the WSD in the occupied and adjacent channels.

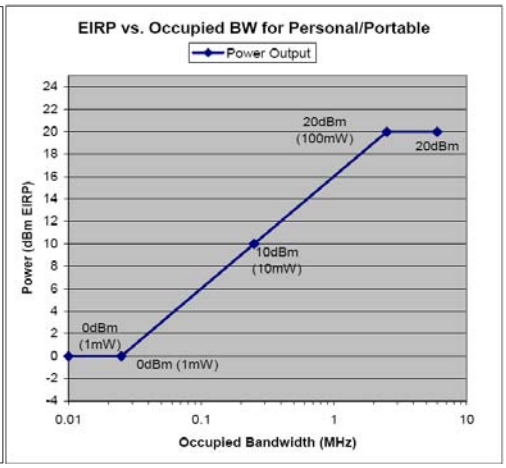
The testing focuses on three specific areas:

1. Confirmation that WSD transmissions do not at any time exceed predefined limits in terms of EIRP and occupied bandwidth. The limits to be utilized are determined by

whether or not the device is classified for operation in a “fixed wireless access” type configuration, or “personal/portable” configuration (the EIRP for the latter is significantly lower). It is also imperative that the WSD power spectral density be checked to ensure that the emissions are as “noise like” as possible, in order to minimize unwanted intermodulation products in adjacent TV channels.

2. Confirmation that the EIRP of a WSD is properly reduced when the device operates in less than the maximum possible occupied bandwidth. One such acceptable relationship between EIRP and occupied bandwidth has been proposed previously by Shure in [1], and is aimed at minimizing the potential for harmful intermodulation products outside of the channel in use. The figures below from our comments illustrate some examples of acceptable EIRP levels for different transmission bandwidths, for both Fixed/Access and Personal/Portable devices.





3. Confirmation that the EIRP transmission mask of the WSD is such that it does not exceed specified levels in the adjacent TV channels.

The table below was taken from the Functional Requirements for the 802.22 Standard [2], It defines the out of band emission limits currently considered for IEEE 802.22 (WRAN) 4W EIRP devices. The requirements were adopted there for the purpose of protecting DTV and wireless microphones. These parameters may thus also be reasonable figures for the preliminary testing of generic White Space Devices, if no other data is available.

	If White Space Device Operates:	
	First adjacent channel to TV or wireless microphone	Second adjacent channel and beyond to TV or wireless microphone
WSD first adjacent channel limit	4.8 uV/m	200 uV/m
WSD second adjacent channel and beyond limit	4.8 uV/m	4.8 uV/m

Test Procedure:

All of these emissions characteristics can be confirmed using common lab equipment (e.g., a spectrum analyzer) that can measure the power spectral density of the transmission from the

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White Space Device under test. The emissions of the device should be measured and recorded under all of its possible operating modes, e.g.:

- Powered on, but not unassociated
- Powered on and associated with another device, but not sending data (i.e., idle)
- Powered on and transmitting data continuously
- Concluding operations on a channel in order to vacate the channel and move to a new one
- Moving to a new channel (i.e., does the device "litter" the spectrum during frequency changes)
- Re-establishing operations on the new channel

3.0 Field Tests

For the field tests, all tests must be done on a radiated basis; i.e., the devices and test equipment shall not be interconnected using coaxial cables. The only path between a transmitter and a receiver will be via radiation.

The recommended field tests are a subset of the laboratory tests. This is partly due to limitations on time and logistics. The following tests should be suitable for field test applications.

1. Ability of the WSD to sense Part 74 device transmissions across a range of conditions and circumstances
2. Actions, or "behaviors" of the WSD in response to detection of Part 74 devices

Venue and Dates:
It is critical that the wireless microphone field tests evaluate typical real-life uses of wireless microphones. It is critical that the Commission test the WSDs in a variety of environments and use models. As such, Shure expects that WSDs will need to be evaluated in field tests occurring in several locations and several different environments. Shure stands ready to assist the Commission in facilitating these field tests and expects to propose additional venues and dates.

At this time, Shure strongly recommends that wireless microphone field tests take place at two Baltimore Ravens National Football League games to be held at the M&T Bank Stadium located in Baltimore, MD. This venue is being fully and carefully coordinated with the NFL and the responsible Society of Broadcast Engineers Game Day Frequency Coordinators (SBE – GDC) in order to provide a real-life environment to test the spectrum sensing capabilities of WSD with respect to wireless microphones, without any disruption to the NFL events occurring in the stadium or their broadcast.

An NFL venue is proposed for wireless microphone testing due to its typical heavy use of wireless equipment, dependence on failsafe wireless coordination for TV broadcast confidence, outdoor location and proximity to strong local DTV stations, widely varying venue landscape and proximity of devices to local TV station news crews. All of these aspects combine to make an NFL venue a very typical real-life use of wireless microphones, therefore it is imperative that WSD spectrum sensing be fully tested to the conditions and layouts suggested below.

The following games are being coordinated and are suggested testing dates as follows:

- December 3 (Monday Night – Baltimore vs. New England, broadcast on ESPN)
- December 9 (Sunday Night – Baltimore vs. Indianapolis, broadcast on NBC)

A seating layout of the M&T Stadium is shown below for the Baltimore Ravens games [6].

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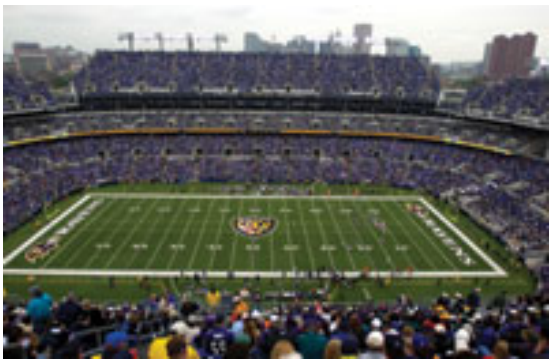
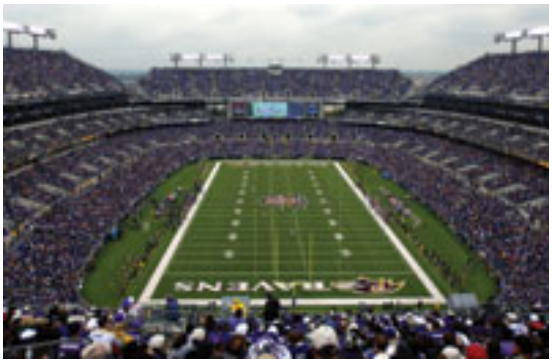
M&T Bank Stadium (Baltimore Ravens)





Test conditions:

Due to the confidential nature of wireless microphone frequencies used for NFL games, the exact frequencies will not be specified in this test plan as in the laboratory tests, but rather coordinated between the FCC and the NFL privately. Additionally, since these tests are being conducted outdoors, the TV spectrum cannot be controlled as in the laboratory tests and therefore, these tests will be subject to the local TV spectrum use in the Baltimore, Maryland area.

It is the intent of Shure and the NFL to have the WSD perform spectrum sensing on both active microphones being used during the football games by the teams and players as well as microphones under the control of the FCC. However, it is NOT the intent of Shure nor the NFL to have the WSD transmit at any time during the game and/or broadcast while

in or near the stadium. As such, the transmit functions of the WSD must be disabled for any testing at a live NFL venue and or nearby event.

In order to exercise the complete characteristics of spectrum sensing of wireless microphones within a typical NFL venue, spectrum sensing by WSD should be performed at several locations within and outside the stadium. Specifically, there are four recommended locations for spectrum sensing to be performed at the Ravens venue:

- In or near the stadium press box
- Within the general stadium seating
- Within the stadium locker rooms and/or equivalent rooms located below the general seating areas
- In the parking lot outside the stadium

These locations have been chosen as representative positions where WSD would exist within this NFL venue, and therefore, would need to correctly sense the presence of wireless microphones so as to not interfere with its transmissions throughout the entire duration of the event (including setup and rehearsal).

3.1 Sensing of Part 74 Devices by White Space Devices.

Test objective: Confirm that the White Space Device includes techniques/algorithms that enable it to reliably detect the presence of Part 74 devices under a variety of conditions and uses within the example NFL venue. In addition, it must be able to do this in the presence of strong DTV signals on adjacent channels (e.g., N+/– 1 and N+/–2 where permitted by locally available TV stations).

NOTE: It is the intent of Shure and the NFL to perform the testing in section 3.1 on live wireless microphones used during the game by the teams and players, therefore WSD transmissions must be disabled for these tests so as to not interfere with the live audio broadcast.

Test procedure:

Measure the sensitivity of the mechanism the WSD employs for detecting wireless microphones. When wireless microphone signals are present within or around the NFL venue, the sensing logic in the WSD must correctly indicate that a wireless microphone is present.

- Sensitivity measurements should be carried out on at least two TV channels within the tuning range of the WSD equipment under test.
- Within each TV channel, test using a single wireless microphone operating on the low channel, mid channel, and high channel frequencies
- Within each TV channel, test using two wireless microphones operating on the low and mid channel frequencies, mid and high channel frequencies, and low and high channel frequencies
- Within each TV channel, test using three wireless microphones operating on the low, mid, and high channel frequencies

Sensitivity tests should be performed in each of the following configurations:

1. Wireless microphones, plus one DTV signal at N+1
2. Wireless microphones, plus one DTV signal at N–1
3. Wireless microphones, plus two DTV signals at N+1 and N–1*

4. Wireless microphones, plus two DTV signals at N+1 and N+2*
5. Wireless microphones, plus two DTV signals at N–1 and N–2*

*Where permitted by locally available DTV signals.

For each of the configurations involving DTV signals in combination with wireless microphones, it is important that the level of the DTV signals involved includes a range from –75 dBm (simulating a weak but usable DTV signal) up to –20 dBm (simulating a very strong DTV signal, such as would be present at an outdoor venue near a TV transmitter). The behavior of the WSD should be observed using various DTV signal levels within this range. It may be necessary to test on several different TV channels or to test in different locations to fully investigate the performance of the WSD, since the DTV signal level at the test site will not be under the control of the operator.

3.2 Dynamic Frequency Selection (DFS) Behavior of White Space Devices When Part 74 Devices Are Detected

Test Objective: Confirm that the WSD takes corrective action within an appropriate time limit when incumbent Part 74 wireless microphone users operating in the same TV channel are detected, in order to ensure that it does not interfere with them. A critical element to the testing will be verification of the WSD's ability to regularly monitor for the presence of Part 74 devices in such a way that it can quickly vacate the channel to avoid interfering. Note that previous tests of WSDs have focused solely on detection, without assessment of required DFS behaviors.

It is worth noting that this testing is critical to perform on WSDs aimed at the personal/portable space. The reason is that sensing could be the primary mechanism by which these devices determine the presence of licensed Part 74 devices (other techniques, such as those based on Geo-location, may not be feasible for portable and mobile devices).

NOTE: It is the intent of Shure and the NFL to perform the testing in section 3.2 on wireless microphones operated under the sole control of the FCC while the WSD's are actively transmitting. Therefore, the tests in section 3.2 will need to be done either prior to or after the live football broadcast is completed to avoid interference with the broadcast. The tests in section 3.2 must be coordinated with the NFL and Game Day Coordinators to test the interference potential of the WSD but ensure no interference to broadcast TV audio signals.

It is also desirable to conduct this test with both analog and digital transmission wireless microphones.

Test Procedure:

1. Configure a pair of WSD transceivers to operate normally (e.g., exchanging and transmitting data) in the desired test TV channel; e.g., channel N.
2. Turn on a Part 74 wireless microphone transmitter and receiver system in the same TV channel N.
3. Confirm that each WSD is able to sense the presence of the wireless microphone transmitter (i.e., the system employs network sensing)
4. Observe the WSD system behavior. Within the "Channel Move Time" (2 sec) after the Part 74 system is turned on, the White Space Devices should cease transmission completely.
5. Repeat the test with multiple wireless microphones
6. Repeat the test for each of the configurations described above with DTV signals present

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References:

[1] Comments of Shure Inc. NPRM in ET Docket Nos 04-186 and 02-380 (November 2004)
[2] Functional Requirements for the 802.22 WRAN Standard, doc IEEE 802.22-05/0007r48, November 2006
[3] ITU-R BS.1534-1 “Method for the Subjective Assessment of Intermediate Sound Quality”, International Telecommunications Union, Geneva, Switzerland, 2001
[4] ETSI Professional Wireless Microphone Standard Draft, ETSI TR 102 546 V1.1.1_0.0.23(2006-10)
[5] Table of DFS Parameters for Wireless Microphone Detection and Interference Avoidance:
[6] Baltimore Ravens Web Site (http://www.baltimoreravens.com/Facilities/Default.aspx?id=66)

DFS Parameter for Wireless Microphone Detection and Interference Avoidance	**Value**
Channel Availability Check Time	60 sec
Non-Occupancy Period	60 minutes
Channel Detection Time	500 msec
Channel Setup Time	2 sec
Channel Opening Transmission Time (Aggregate transmission time)	D/U dependent
Channel Move Time (In-service monitoring)	2 sec
Channel Closing Transmission Time (Aggregate transmission time)	D/U dependent
Interference Detection Threshold	-116 dBm*

*Interference detection threshold revised to conform to FCC recommendation.

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